Aug. 9, 1949. H. C. RIORDAN 2,478,320

WARNING SIGNAL FOR CONTINUOUSLY OPERATED RADIO RECEIVERS

Filed May 16, 1946

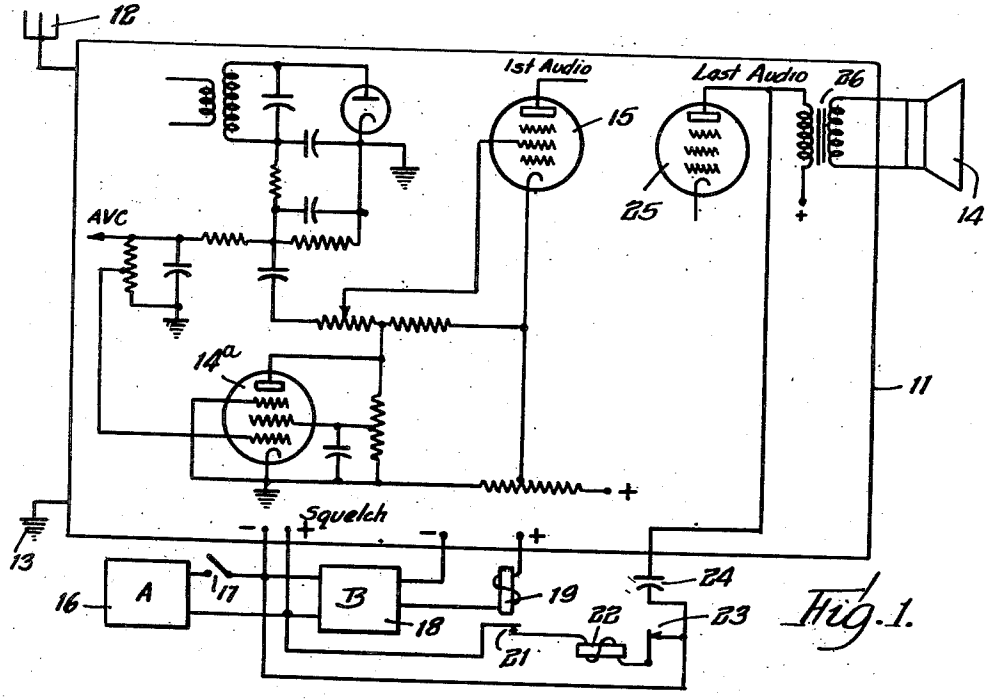


Fig. 1.

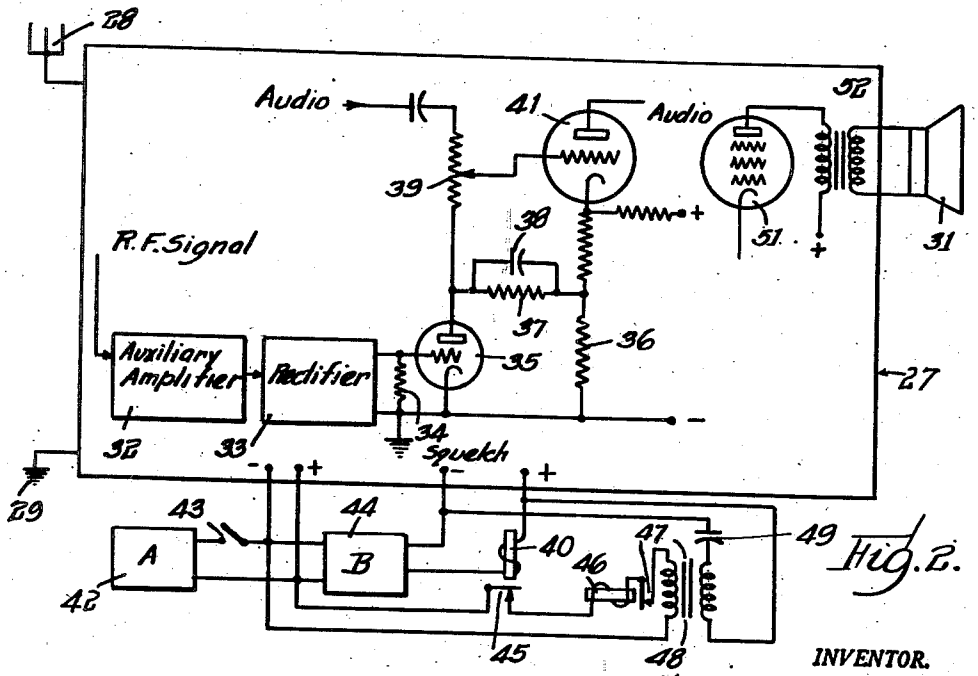


Fig. 2.

INVENTOR.

Howard C. Riordan

BY

Stone, Autmar & Simon

Attys

Patented Aug. 9, 1949

2,478,320

UNITED STATES PATENT OFFICE

2,478,320

WARNING SIGNAL FOR CONTINUOUSLY OPERATED RADIO RECEIVERS

Howard C. Riordan, Oak Park, Ill.

Application May 16, 1946, Serial No. 670,082

7 Claims. (Cl. 250—20)

1

The present invention relates to a signal or indicating system particularly adapted for use in conjunction with certain types of radio receivers.

Various types of radio receivers used for commercial purposes such as the commercial communications receivers which are kept energized continuously are provided with certain circuits for quieting the loud speaker during the time that no signal is being received. Such circuits have been given various names such as muting, quieting or squelch systems, tuning silencers and interchannel noise suppressors. Such devices have also sometimes been referred to as "codan" from the first letters of the phrase "carrier-operated device anti-noise."

While the use of muting systems or squelch circuits has the advantage of rendering quiet the loud speaker during the time that no signal is being received, a receiver so equipped has the disadvantage of not indicating when the receiver becomes inoperative. In many communication systems such as those employed by the airlines and various police departments, regular checks are made by transmissions at periodic intervals. While such checks generally are sufficient to indicate the operativeness of the receiver, it has been found particularly in police systems that a receiver will become inoperative and the driver of the car will miss the regular transmission or will miss emergency calls. The driver through no fault of his has assumed that the squelch circuit has quieted the receiver and that the receiver is in readiness to respond to any incoming signal. The most frequent cause for the inoperativeness of the police car radio is the failure of the B-voltage supply. Occasionally one or more tubes will burn out thus also rendering inoperative the receiver. It of course will be appreciated that it is also desirable in the case of fixed station receivers to have an indication or signal warning of the inoperative condition of the receiver.

In accordance with the present invention it is proposed to provide a system which in response to the failure of or an abnormal change in the B-supply voltage will initiate operation of a signal device or indicator to give warning of the inoperativeness of a radio receiver. Upon occurrence of such condition an audio frequency signal is generated which, in the embodiment herein illustrated, is supplied to the loud speaker so that a characteristic tone or signal is indicative of an inoperative or defective radio receiver. It is contemplated, however, that other signal means than the loud speaker may be energized pursuant to circuit failure, wherefore the term "loud speaker" as used herein is intended to also denote other audible warning means.

It, therefore, is an object of the present invention to provide for a radio receiver having a muting or squelch system, a signal system which will indicate the inoperative condition of the receiver.

2

It is a further object of the present invention to provide an arrangement responsive to the failure of or an abnormal change in the B-voltage supply of a radio receiver to provide a warning signal.

A still further object of the present invention is to provide a relatively simple system and apparatus which may be applied to existing radio receivers having muting or squelch circuits which will be relatively economical to manufacture and install and which will require a minimum of modification of the radio receiver.

Other and further objects of the present invention subsequently will become apparent by reference to the following description taken in conjunction with the accompanying drawing wherein

Figure 1 is a diagrammatic representation of the application of the present invention to a radio receiver having a squelch system; and

Figure 2 shows another application of the present invention to a similar radio receiver.

In commercial radio receivers of the type having a muting or squelch system, an arrangement is provided for producing a characteristic audible signal tone in the loud speaker whenever the condition of the radio receiver deviates from normal. An arrangement of this type is of course desirable for all types of radio receivers whether such receivers are of the fixed station type or of the mobile type. In order to facilitate and simplify the disclosure and application of the present invention, the invention will be described as being applied to mobile radio receivers which are energized from a storage battery.

The application of the present invention in one manner is illustrated in Figure 1 wherein there is provided a radio receiver of the thermionic tube communications type indicated by the rectangle 11 which is provided with an antenna 12, a ground connection 13 and a loud speaker or audio signal reproducer 14. The receiver is provided with a squelch circuit. Squelch circuits or systems of this type have been known as muting, quieting systems, tuning silencers and interchannel noise suppressors. For the purposes of the present invention any type of squelch circuit may be employed. A typical muting system is shown as having been incorporated in the receiver 11. Here a vacuum tube 14a is arranged so that it biases the grid of the first audio tube 15 beyond cut off unless the grid bias applied to the vacuum tube 14a approaches or exceeds cut-off. The normal automatic volume control system is employed to bias the vacuum tube 14a to make the receiver inoperative until a carrier signal of predeter-

mined amplitude is received. Thus the automatic volume control and the tube 14a are components of means responsive to a condition of no-signal modulation of a received carrier wave for suppressing signal energization of the audio signal reproducer 14, and this is accomplished by biasing a grid of a tube controlling energization of such reproducer.

The receiver 11 being of the mobile station type is energized from a source of A potential which may be a storage battery indicated by the rectangle 16. Interposed between the receiver 11 and the source of power A is an off-on switch 17. Closing of the switch 17 supplies filament voltage to the tubes of the receiver 11 and at the same time supplies power to the B supply unit 18 which normally is constructed as a part of the receiver 11. The B supply unit for supplying plate current to the plates of the tubes for energizing the same may be any suitable circuit such as a vibrator inverter and rectifier arrangement which through suitable filter circuits is arranged to supply high voltage direct current to the receiver 11. Current from the supply A of plate current is led to the receiver through high voltage plate current supply conductors which are respectively positive and negative. In the positive high voltage lead there is inserted the coil of a break contact relay 19. The relay 19 is provided with a pair of contacts 21 which are normally closed whenever the relay 19 is de-energized. During normal operation of the radio receiver 11 current for the anodes and screen grids of the various tubes is supplied from the B-power unit through the relay 19 thereby energizing this relay. The relay 19 is so constructed or arranged that it attracts its armature whenever the current supplied to the receiver is equal to the minimum normal current. The relay 19 is arranged to permit its armature to drop whenever the current flowing through it decreases a small amount just below the minimum amount of current which flows to the receiver when the squelch circuit is operating and the receiver is not receiving any signal voltage. The relay 19 therefore is arranged so as to be responsive to the failure of the B-supply 18, and also to be responsive to a predetermined reduction of the current flow through relay 19 which occurs whenever one or more of the tubes of the radio receiver 11 ceases to function.

Assuming now that the relay 19 becomes de-energized through failure of the B-supply unit 18 or through failure of one or more of the tubes in the receiver 11, the contacts 21 are closed thus completing a circuit to an electromagnet or relay coil 22 which is connected in series with a pair of break contacts 23 which complete a circuit to the conductors extending to the A supply unit 16. When the contacts 21 are closed, the electromagnet 22 is energized so that it attracts its armature and breaks the contacts 23. The contacts therefore will vibrate from one position to another so as to comprise a buzzer circuit. A coupling capacitor 24 is connected between the anode of the last audio tube 25 and the contacts 23. The condenser or coupling capacitor 24 is in a circuit which extends through the output or audio transformer 26 and the remaining circuit elements of the receiver 11 back to the negative side of the B supply and one side of the A supply. The condenser 24 therefore provides an alternating current circuit through the transformer 26 so that the making and breaking of the contacts 23 produces an alternating current signal in the loud speaker 14. Whenever this signal is heard, the receiver operator will know that the receiver is no longer in normal operating condition. In the case of a mobile receiver such as employed in a police patrol car, the operator of course will thereupon immediately report back to the central station the fact that the receiver no longer is capable of receiving the central station signals.

Another manner of applying the principles of the present invention to a radio receiver is illustrated diagrammatically in Figure 2 where the receiver 27 has an antenna 28, a ground 29 and a loud speaker 31. A different type of squelch circuit is illustrated which has an auxiliary amplifier 32 energized from the radio frequency signal obtained from the main radio frequency amplifier. The auxiliary amplifier 32 supplies energy to a rectifier 33 which develops a voltage across a resistor 34. This voltage is applied to the grid of a squelch tube 35. The squelch tube 35 is connected across or in parallel with a circuit including two series resistors 36 and 37. The latter resistor 37 is by-passed by a capacitor 38. The resistor 37 which is connected to the anode of the vacuum tube 35 is connected to the grid circuit resistor 39 of the audio amplifier tube 41. The squelch tube 35 operates to bias the audio tube 41 far beyond cut off thereby silencing the audio frequency channel. If a sufficiently strong carrier signal is received by the receiver, the radio frequency signal unblocks the first audio tube by biasing off the squelch tube 35 and developing a potential across resistor 34. This has the effect of removing the low impedance of the vacuum tube 35 from across the resistors 36 and 37, the resistor 37 having a relatively high value. When the squelch tube 35 is operative to silence the audio frequency channel, it is in effect a low resistance between the junction of the resistors 37 and 39 and the negative terminal of the resistor 36.

Again the receiver 27 has been assumed as being energized from a storage battery or A supply indicated by the rectangle 42 which is connected to a switch 43. The switch 43 controls the supply of A power to the receiver 27 and to the B supply unit 44. The B supply unit 44 in one lead is provided with a relay 40 which when energized by normal B current serves to maintain open a pair of contacts 45. The contacts 45 are connected in series between one conductor from the A supply and a relay or electromagnetic buzzer coil 46 having a pair of contacts 47. The contacts 47 are connected through the primary winding of a transformer 48 to the other side of the A supply 42. The secondary winding of the transformer 48 is connected to the B supply terminals of the receiver through a blocking capacitor 49.

When the current flowing through the relay 40 drops below the normal amount due to the failure of the B supply unit or the failure of one or more of the tubes 27, the contacts 45 are closed. The closing of the contacts 45 supplies energy to the relay coil 46 so that the contacts 47 are opened and then closed intermittently. The pulsations of direct current through the transformer 48 produce a high voltage alternating current in the secondary winding which passes through the coupling or isolating capacitor 49 to the B circuit of the receiver. Thus alternating current will be applied to the anode of the last audio tube 51 as well as other audio tubes with the result that an alternating current signal is transmitted through the output transformer 52 to the loud speaker 31. This alternating current signal will produce an audible signal characteristic of a warning which is readily detected by the operator of the receiver.

From the arrangement shown in Figure 2 it of course will suggest itself to those skilled in the art that in the instance of alternating current energized fixed station radio receivers, alternating current may be derived directly from the normal alternating current source instead of by means of a buzzer and transformer arrangement. It further will suggest itself to those skilled in the art that the principles of the invention may otherwise be employed by arranging for an oscillating signal generator to be placed in operation upon occurrence of abnormal conditions as detected by a change in the plate or B supply current.

From the representations of the receivers shown in Figures 1 and 2 it will furthermore be appreciated that the principles of the present invention may be applied to any type of radio receiver provided with a squelch or muting system irrespective of the type of receiver or the type of squelch circuit employed.

While for the purpose of illustrating and describing the present invention, certain circuit arrangements have been shown in the drawing, it is to be understood that the invention is not to be limited thereby since such modifications in the circuit arrangements and in the instrumentalities employed are contemplated as may be commensurate with the spirit and scope of the invention set forth in the following claims.

This invention is hereby claimed as follows:

1. In a radio receiver of the thermionic tube type wherein the plates of tubes thereof are energizable from a supply of plate current, and such receiver having means responsive to a condition of carrier wave amplitude diminution for biasing a grid of a tube controlling energization of an audio signal reproducer; the combination of means responsive to a predetermined reduction in plate current supplied to tubes of such receiver for initiating the generation of fluctuating current, and means for utilizing a component of said fluctuating current to produce a warning signal.

2. In a radio receiver of the thermionic tube type wherein the plates of tubes thereof are energizable from a supply of plate current, and such receiver having means responsive to a condition of carrier wave amplitude diminution for suppressing signal energization of an audio signal reproducer; the combination of means connected in series with the plate current supply of said receiver for detecting a predetermined diminution in such plate current, means responsive to such detection of said first means for generating a signal current of audio frequency, and means for coupling said audio frequency signal current to the audio signal reproducer.

3. In a radio receiver of the thermionic tube type wherein the plates of tubes thereof are energizable through a plate current supply conductor and such receiver having means responsive to a condition of carrier wave amplitude diminution for supressing signal energization of an audio signal reproducer; the combination of a relay connected in series with the plate current supply conductor of said receiver, said relay being provided with a pair of contacts which are biased to close pursuant to a predetermined decrease in such plate current, a signal generating device arranged to be energized from a low voltage source of current, electric circuit means including said contacts and operable to energize said signal energizing device from said low voltage source of current when the contacts are closed, and means

for coupling said signal generating device to said signal reproducer.

4. In a radio receiver of the thermionic tube type wherein the plates of tubes thereof are energizable through a plate current supply conductor, and such receiver having means responsive to a condition of carrier wave amplitude diminution for suppressing signal energization of an audio signal reproducer; the combination of a relay having contacts and connected in circuit with said plate current supply conductor for energization by plate current supplied to said receiver to cause such contacts to be open and to cause closing of such contacts incident to the plate current predeterminedly diminishing, and means energized under control of said contacts and by the closing thereof for supplying an audio frequency warning signal current to said signal reproducer.

5. In a radio receiver of the thermionic tube type having an audio signal reproducer energized from an audio frequency amplifier circuit and also having means responsive to a condition of carrier wave amplitude diminution for suppressing signal energization of said reproducer; the combination of a source of filament voltage, a source of plate voltage, a relay connected between said receiver and said source of plate voltage so as to be energized by the plate current, said relay being provided with a field coil and pair of contacts, said relay being sensitive to plate current above a predetermined minimum through its said coil to cause separation of said contacts and to cause closing of said contacts responsively to the plate current through said coil diminishing below a certain minimum, and an audio frequency signal generating circuit including said contacts which are closable to cause energization of such circuit from said source of filament voltage, and means for coupling said audio frequency signal generating circuit to said audio frequency amplifier circuit.

6. In a radio receiver of the thermionic tube type wherein there is means for conducting current to the plates of said tubes; the combination of means for initiating the generation of undulatory current responsively to a predetermined reduction in the plate current supplied to the receiver, and means for supplying a component of said undulatory current to produce a warning signal.

7. In a radio receiver of the thermionic tube type wherein the plates of tubes thereof are energizable from a supply of plate current, and such receiver having means responsive to a condition of carrier wave amplitude diminution for suppressing signal energization of an audio signal reproducer; the combination of means responsive to a predetermined diminuition in the plate current supplied to tubes of such receiver for causing generation of an audio frequency signal current, and means for utilizing a component of such signal current to produce a warning signal.

HOWARD C. RIORDAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,503,709	Pruden	Aug. 5, 1924
1,573,801	Brown	Feb. 23, 1926
2,096,874	Beers	Oct. 26, 1937
2,197,516	Case	Apr. 16, 1940